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Background

Little research has been conducted on Varnish Clams in the Pacific Northwest to date: a 2001 DFO report explored the viability of a Varnish Clam fishery;1 Dr. James Byers investigated the impacts of sediment types and predation2; and Dr. Sarah Dudas and colleagues have investigated the species’ geographic locations, life history traits, and preliminary susceptibility to predation 3–5. Only Byers’ study focuses on impacts of the abiotic environment on Varnish Clam population dynamics. However, only two tidal elevations and sediment types (sand and mud + cobble) were considered, and the proximity to freshwater, a factor deemed significant by Dudas et al., was not studied2,5 The primary goal of this study was to determine the relationship between the abiotic factors and varnish clam population parameters in Porteau Cove Provincial Park. This research aimed to meet these goals by studying population density and individual size as a function of four abiotic variables: sediment type, burial depth, intertidal elevation, and proximity to freshwater.

Methods

The null hypothesis in this study is that there is no relationship between any of the measured values.

The overall test that will be utilized to study this data will be a couple of ANCOVAs or simply one MANCOVA. First there will exploratory phase to see how the different variables relate and will fit into the larger test(s). The first of these is the sediment data. Because I am not interested in the frequency or density within each hole, I need to find some way to group the data from each hole to fit into a singular variable that can be put into the (M)ANCOVA. I will do this by exploring how the different variable options (e.g. model sediment category, sand:gravel ratio, percentage of sand) relate to the presence/absence and density found within the clam data. In creating the categories both the broader literature and the data will be considered. The next step will be to look at the strengths of the correlations between the explanatory variables as well as the two response variables (presence/absence and density).

I will then test for normality and homogeneity of the variances for the categorical and continuous variables. For the continuous variables by looking at whether or not the residuals are normally distributed, which is an assumption for linear regression. In testing the categorical variable, I will look at whether the size of clams and density are normally distributed between each distance from the stream, each burial depth, and each side of the stream. The numerical test statistics will be calculated, and the results visualized.

After all of these tests have been run I will either run two ANCOVAs (one for density and one for clam size) or one MANVOVA, as long as my variables are normally distributed. Once the variables that are statistically significant have been found, those variables will be analyzed further though linear regression and then Shapiro-Wilks tests.

Goals for the final paper

The paper itself will include an introduction, a detailed method, results, and a discussion section. The brief introduction will provide information on why this research is important. The methods section will consist of a detailed explanation of what statistical analysis were used, why, and how. The results will explain the key findings from the statistical analysis and provide some of the plots and or tables created during the analysis, along with complete figure captions. Finally, there will be a brief discussion which will include a brief overview of the findings as well as the process.

The other deliverables will be periodically uploaded to github and will include a complete raw data set, a completely reproducible set of R scripts, and all of the plots.

A schedule can be found on the [github](https://github.com/kjdurovich/R.Keystone).

Sources

1. Gillespie, G. E., Rusch, B., Gormican, S. J., Marshal, R. & Munroe, D. Further Investigations of the Fisheries Potential of the Exotic Varnish Clam (Nuttallia obscurata) in British Columbia. 60 (2001).

2. Byers, J. E. Physical Habitat Attribute Mediates Biotic Resistance to Non-Indigenous Species Invasion. *Oecologia* **130**, 146–156 (2002).

3. Dudas, S. E., Dower, J. F. & Anholt, B. R. Invasion Dynamics of the Varnish Clam (Nuttallia obscurata): A Matrix Demographic Modeling Approach. *Ecology* **88**, 2084–2093 (2007).

4. Dudas, S. E. PhD Thesis: Invasion dynamics of a non-indigenous bivalve, Nuttallia obscurata, (Reeve 1857), in the Northeast Pacific. (2005).

5. Dudas, S. E. & Dower, J. F. Reproductive ecology and dispersal potential of varnish clam Nuttallia obscurata, a recent invader in the Northeast Pacific Ocean. *Marine Ecology Progress Series* **320**, 195–205 (2006).